Small, Fast TES Microcalorimters with Unprecedented X-ray Spectral Performance

M.E. Eckart, J.S. Adams, C.N. Bailey, S.R. Bandler, J.A. Chervenak, F.M. Finkbeiner, R.L. Kelley, C.A. Kilbourne, F.S. Porter, J.E. Sadleir, S.J. Smith (NASA/GSFC), G.C. Hilton, K.D. Irwin, L.R. Vale (NIST/Boulder)

Driven initially by the desire for X-ray microcalorimeter arrays suitable for imaging the dynamic solar corona, we have developed a transition-edge-sensor (TES) microcalorimeter optimization that exhibits a unique combination of high spectral resolving power and a wide X-ray bandpass. These devices have achieved spectral performance of dE ~ 1.3 eV FWHM at 1.5 keV, 1.6 eV at 6 keV, and 2.0 eV at 8 keV, using small TESs (e.g., ~35 um x 35 um) that operate in a regime in which the superconducting transition is highly current dependent. In order to accommodate high X-ray count rates, the devices sit directly on a solid substrate instead of on membranes, and we use an embedded heatsinking layer to reduce pixel-to-pixel crosstalk. We will present results from devices with a range of TES and absorber sizes, and from device wafers with varied embedded heatsink materials. This contribution will focus on count-rate capabilities, including a discussion of the trade-off between count rate and energy resolution, and the heatsinking design. We will also present preliminary tests of array readout using a code-division multiplexed SQUID readout scheme, which may be necessary to enable large arrays of these fast devices.